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High permittivity dielectric elastomers with ionic liquid (IL) loading

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Dielectric elastomers (DEs) represent a promising transducer technology, due to their excellent ability to undergo large and reversible deformations under an applied electric field. The most obvious challenge that current elastomers face is the high driving voltages necessary to activate the elastomers. An effective way to overcome this shortcoming is to increase the permittivity of DEs. Ionic liquids (ILs) have high permittivity and conductivity. It is therefore meaningful to blend ILs in elastomers to increase their dielectric permittivity while focusing on maintaining the non-conductive nature of silicone elastomers. In this work, high permittivity dielectric elastomers were prepared through the synthesis of silicone elastomers loaded with ILs. The influence of the structure and amount of ILs on the material properties was discussed, and other important properties for the material's application as DEs, such as resulting gel fractions and mechanical properties, were investigated. It was found that 1-butyl-3-methylimidazolium hexafluoroantimonate ($BmimSbF_6$) is the most suitable IL for the given system, and the dielectric permittivity of the elastomers increased with the increasing amount content of $BmimSbF_6$. A simple figure of merit (F_{om}) for actuators was used and the resulting F_{om} of elastomer with 90 phr IL loading is 10.40, compared to that of the pristine elastomer indicating a great potential.